PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

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PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT
(PCT Rule 71.1)

Date of mailing *(day/month/year)*	24.06.2004
Applicant's or agent's file reference: P 5153 PC00	**IMPORTANT NOTIFICATION**

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/IS 03/00012	14.03.2003	14.03.2002

Applicant: ND A ISLANDI EHF. et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

The applicant's attention is drawn to Article 33(5), which provides that the criteria of novelty, inventive step and industrial applicability described in Article 33(2) to (4) merely serve the purposes of international preliminary examination and that "any Contracting State may apply additional or different criteria for the purposes of deciding whether, in that State, the claimed inventions is patentable or not" (see also Article 27(5)). Such additional criteria may relate, for example, to exemptions from patentability, requirements for enabling disclosure, clarity and support for the claims.

Name and mailing address of the international preliminary examining authority:	Authorized Officer
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Comia Costa, M Tel. +49 89 2399-7391

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P 5153 PC00	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/IS 03/00012	International filing date *(day/month/year)* 14.03.2003	Priority date *(day/month/year)* 14.03.2002
International Patent Classification (IPC) or both national classification and IPC G07C5/08		
Applicant ND A ISLANDI EHF. et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 7 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 17 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the opinion
   - II ☐ Priority
   - III ☒ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
08.10.2003	24.06.2004
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Kemény, M Telephone No. +49 89 2399-7941

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IS 03/00012

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:

Description, Pages

1, 5, 7, 13-15, 18	as published
2, 4, 6, 8, 10-12, 16, 17	filed with telefax on 21.05.2004
3, 9	filed with telefax on 04.06.2004

Claims, Numbers

1-36	filed with telefax on 04.06.2004

Drawings, Sheets

1/4-4/4	as published

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).

   ☐ the language of publication of the international application (under Rule 48.3(b)).

   ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   ☐ contained in the international application in written form.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority in written form.

   ☐ furnished subsequently to this Authority in computer readable form.

   ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   ☐ the description, pages:

   ☐ the claims, Nos.:

   ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

   ☐ the entire international application,

   ☒ claims Nos. 22,23

   because:

   ☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (specify):

   ☒ the description, claims or drawings *(indicate particular elements below)* or said claims Nos. 22,23 are so unclear that no meaningful opinion could be formed *(specify)*:

   see separate sheet

   ☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

   ☐ no international search report has been established for the said claims Nos.

2. A meaningful international preliminary examination cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

   ☐ the written form has not been furnished or does not comply with the Standard.

   ☐ the computer readable form has not been furnished or does not comply with the Standard.

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-21,24-36
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-21,24-36
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-21,24-36
	No:	Claims	

2. Citations and explanations

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IS 03/00012

see separate sheet

1 Prior Art

Reference is made to the following documents:

D1: US 2002/029109 A1 (TSOI LEO S C ET AL) 7 March 2002 (2002-03-07)
D2: US 2001/047244 A1 (HARRISON CHRISTOPHER G ET AL) 29 November 2001 (2001-11-29)
D3: EP-A-0 545 636 (NAVSYS CORP) 9 June 1993 (1993-06-09)
D4: US-A-6 005 513 (HARDESTY W MARK) 21 December 1999 (1999-12-21)
D5: US-A-6 115 655 (EVANS PAUL H ET AL) 5 September 2000 (2000-09-05)
D6: EP-A-1 158 273 (DATA TEC CO LTD) 28 November 2001 (2001-11-28)
D7: US-A-5 787 384 (JOHNSON GREGORY BENGT) 28 July 1998 (1998-07-28)
D8: US-A-6 064 970 (HEINEN JOHN PATRICK ET AL) 16 May 2000 (2000-05-16)
D9: US-A-5 736 962 (TENDLER ROBERT K) 7 April 1998 (1998-04-07)
D10: US-A-4 402 049 (GRAY JACK) 30 August 1983 (1983-08-30)
D11: WO 98/43192 A (SCIENTIFIC ATLANTA) 1 October 1998 (1998-10-01)

2 Summary

2.1 No opinion could be established on claim 22 and 23, as this claim is massively unclear. Further, claims 22, 26, 30-31 and claim 34 are also not clear, thus not meeting the requirements of Article 6 PCT.

2.2 Claims 1-21 and 24-36 are novel and inventive within the meaning of Article 33(2)(3) PCT, and therefore meet the requirements of Article 33(1) PCT.

Re Item III

Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

3 Claims 22 and 23

Claim 22, claiming the moving object to be an airplane, seems to be depending on other claims, but it is not stated in the documents on file on which claims this claim is depending. The same reasoning will be applied to claim 23, which is dependent on claim 22. Consequently, an opinion cannot be established on these two claims.

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

4 Novelty and Inventive Step

4.1 Independent Claim 26

The document D1 discloses (the references in parentheses applying to this document):

1) a registration system for determining a track record of a moving object by determining at least one characteristic property of the object ("(...) a vehicle operation and position recording system (:..)", [0002]), the system comprising
2) means for receiving at least three GPS coordinates, each of the coordinates comprising the current position of the moving object ant the current time, at which the moving object is at the current position ("... utilizing a global positioning system", [0002]);
3) means for storing said coordinates data in a coordinates data storage means ("(...) records positional and operational data of the vehicle. The recording device includes a GPS receiver, a control unit and a storage deice", [0005]);
4) utilizing the at least three GPS coordinates data for determining said at least one characteristic properties of the moving object ("(...) provides in-vehicle recording device with such status and operational information as vehicle velocity, distance travelled, amount of fuel remaining and engine temperature.",[0018]);
5) and thereby obtaining a track record for the moving object (implicit);

6) wherein said track record comprises information related to:
   - direction of movement
   - velocity

   ("Based on the time difference between positions, a velocity of the base vehicle can also be computed.",[0022])
7) and wherein said track data are utilized to create user information ("The stored data of in-vehicle recording device 100 can be used to determine whether the vehicle has been operated in excess of legal speed limit or whether the vehicle has been driven outside a permissible area", [0022]).

The difference between claim 26 and D1 is that the track record further comprises information related to perpendicular acceleration. Therefore, the claim must be considered novel within the meaning of Article 33(2) PCT.

From this difference, the following technical problem to be solved by the person skilled in the art can be formulated as:

Having registration system for determining a track record of a moving object, how to determine in which manner the object is steered and how accurately it maintains it's route.

Neither D1 nor the other documents cited in the international search report reveals the perpendicular (or lateral) acceleration as being an important physical factor, nor how this acceleration is being obtained.

Therefore, claim 26 involves an inventive step within the meaning of Article 33(3) PCT. The requirements of Article 33(1) PCT are met.

4.2 Independent Claim 1

The same reasoning applies, mutatis mutandis, to the subject-matter of the corresponding independent claim 1, which therefore is also considered new and inventive.

It is apparent that there is a need for device, a data storing and reporter means, for obtaining a track record of a moving object.

In US 5,805,079 a system and method is presented for monitoring movements and performance of a motor vehicle, in order to locate it and determine the manner in which it is driven. This is solved by evaluating and recording the driving method over a period of time. One of the variables that is monitored is the acceleration or deceleration of the vehicle, determined by a sensing module. From the acceleration the location, the speed and direction of travel is calculated. It is however mentioned that the position of the vehicle may be determined from the Global-positioning-system (GPS). The operation of the system is controlled with a microprocessor, wherein a separate performance analysing computer with a fuzzy logic circuitry and a neural network circuit is provided to process data collected from the sensing device to analyse how the vehicle is driven.

Another invention is described in the US5,919,239-A patent, where a GPC receiver obtains GPS signals and automatically or manually stores information such as position and time of position. The system in this invention sends information from system/device to computer in a control unit where a track record can be created. A similar device has been described for airplanes in JP 10035593. A tracking recorder for three-dimenstional positioning utilises GPS coordinates and calculates from these coordinates variables such as latitude, longitude and altitude. These informations can be used afterwards to show the flight route.

US 2002/029109 A1 discloses s system for recording positional and operational data of a vehicle including a GPS receiver and a storage means for GPS data. The stored data may comprise parameters such as velocity and distance travelled, as well as supervision of a moving object with regard to a three-dimensional frame set.

The problem with the above systems is how complicated they are and the lack of real time processing and communication of collected and calculated data obtained and processed by these systems. For example, these systems do not utilize the GPS coordinates in order to determine variables such as the acceleration and the ~~centripetal acceleration~~perpendicular acceleration, which is important for determining in which manner a moving object is steered and how accurately it maintains it's route.

Description of the invention

It is an object of the present invention to provide a simple method and a low cost and compact system for obtaining a track record of a moving object, and thereby reducing accident rate. It is a further object of the present invention to provide a method and a

system for utilization as a data collection, processing and a reporter system for moving objects such as aircrafts and ships. This system uses GPS coordinates and real time processing of for monitoring and reporting the objects position as well as other physical parameters, such as speed; acceleration and centripetal acceleration of the moving object

According to the first aspect, the present invention relates to a method for determining a track record of a moving object by determining at least one characteristic properties of the object, said method comprising:

- receiving at least three Global-Positioning-System (GPS) coordinates, each of the coordinates comprising the current position of the moving object and the current time, at which the moving object is at the current position,
- storing said coordinates data in a storage means,
- utilizing the at least three coordinates for determining said plurality of characteristic properties of the moving object,

and thereby obtaining a track record for the moving object, wherein the track record comprises information related to:

- direction of movement
- velocity
- perpendicular acceleration

and wherein said track record data is utilized to create user information.

Preferably, the coordinates data are stored as at least one data package comprising one timestamp coordinate point as a reference point for said at least one data package, the timestamp giving the absolute position and absolute time of the moving object, and a plurality of coordinate data points as a deviation from the timestamp coordinate point. As an example the data package consists of 28 GPS coordinates points, including the GPS timestamp coordinate point. The number of data in each package is however not essential. The timestamp point requires much space because of all the information, i.e. the exact location (global) and the exact time. The additional points in the data package use however the timestamp as a reference point, and therefore instead of giving the exact position and the exact time of each coordinate point, which is very space

demanding, the deviation from the timestamp is used and stored. This minimizes the memory required for storing each data point. Accordingly, each data package may be regarded as one coordinate system with the timestamp as the reference point. By using a plurality of such data package, and therefore defining a new timestamp point, the errors are minimized, due to the fact that the deviation from these reference points are being registered and stored, and not the absolute GPS-coordinate points.

In one embodiment the stored GPS coordinates data is transmitted to a computer system to a receiver side that is provided with a computer program for determining said at least one characteristic property of the moving object. This transmission may be a wireless transmission, such as through a satellite system or telephone network or the transmission may be through plugging the system to a computer system. In another preferred embodiment said characteristic property of the moving object may be determined and optionally stored prior to transmitting the data, whether or not the data is the GPS coordinates or said characteristic property data or both are transmitted to a receiver side, wherein the transmission may be as mentioned above.

Both these embodiments depend on how compact the system is supposed to be. If the computer system is on the receiver side the system may be more compact, such as in the size range of box of matches. The coordinates data may be stored as at least one data package, the at least one data package comprising at least one timestamp coordinate point as a reference point for said at least one data package, the timestamp giving the absolute position and absolute time of the moving object, and a plurality of coordinate data points as a deviation from the timestamp coordinate point. This methodology requires a lot less space than conventional methods and is therefore less costly.

The moving object may be a motor running vehicle, wherein the at least one characteristic property is at least one of the following:

- the ~~centripetal acceleration~~perpendicular acceleration of the moving object a_{cent},
- the acceleration of the moving object a,
- the velocity of the moving object v,
- the total travelled distance of the moving object s,

wherein the velocity database includes information about upper and lower velocity limits in certain areas.

A predetermined upper- and lower limit of the at least one characteristic property may be defined, mainly for the track record. Thus the track record of the moving object may be based on the data that exceeds said predetermined limits such as the velocity and, the acceleration, both linear ~~or the~~and lateral acceleration (perpendicular acceleration or centripetal acceleration) to the direction of the moving vehicle ~~centripetal acceleration~~. The track record may also contain information relating to position of the vehicle. These predetermined limits may also be used as a warning signal, indicating when the moving object is driven to fast, when the acceleration is to large etc.

The reading of the first GPS coordinates data may be bound to a minimum velocity of the object, i.e. if the object exceeds a predetermined velocity limit, which may as an example be 5 km/hour, the first GPS data is collected.

Calculations of other physical (dynamical) parameters, where the GPS coordinates are employed, are also possible.

In one embodiment means for obtaining at least one environmental parameter is provided, wherein each of said parameters can be associated with a GPS coordinate. These parameters could for instance be precipitation, temperature, moisture, wind-speed. Under certain circumstances the at least one environmental parameter could influence how the upper-and lower limit of the at least one characteristics property is defined. As an example, if weather conditions would change resulting in icing on roads, that information could be stored in a database and transformed into a signal resulting in a lowered speed limit on the roads in a given area.

Accordingly, the track record, which may be coordinates or any of the above mentioned physical quantities (characteristic property) are stored and given an exact location with a time. The time period in which these characteristic properties were determined may be based on the time from starting the automobile until it is stopped. In one embodiment the receiving of the first GPS coordinates may be based on that the automobile is moving and exceeds said predetermined limits. If the automobile is under this minimum velocity, no data is collected and stored. If the automobile exceeds this minimum velocity the first

limits, such as velocity upper limit or acceleration upper limit, the event would be registered with location and time.

An example of an application is calculation of additional taxes for diesel automobiles, such as jeeps, that pollute more than many other automobiles. The calculations could be based on the following criterion:

- urban driving and
- rural driving.

The charging could, as an example, be lower if the automobile is driven in rural areas than in the city. Therefore, by keeping track of where the automobile was driven, the charging per kilometre could be set accordingly.

In another preferred embodiment the moving object is an aircraft, wherein the file history (the track record) may comprise at least one of the following:

- Whether or not the aircraft is inside recommended 3-dimensional geo-fence,
- speed and/or variations thereof,
- linear acceleration,
- ~~centripetal acceleration~~perpendicular acceleration
- altitude and/or variations thereof, and
- position,

wherein real time processing of said data can be transformed into a signal and obtained by a receiver. In this case the receiver would be air-traffic controller~~ing~~.

The rate of collecting the GPS-coordinates and/or determining the at least one characteristic property data of the moving object may be as an example every 0.1-2 seconds, including 0.5-1.5 seconds, including 0.8-1.2 seconds, wherein preferably the characteristic property data is transmitted to a receiver repeatedly. In the case that the moving object is an aircraft, this is of essential importance so the exact trajectory and orientation of the aircraft is determined frequently. The receiver would in this particular case bye the air-traffic control.

In still another embodiment the system is provided with a means for receiving information, such as from air-traffic control, if the moving object is an airplane. This information could, as an example, be warnings. In the case the moving object is a motor running vehicle, these warnings could indicate when vehicle is outside the range defined by the upper and lower limit of the at least one characteristic property. This could, as an example, be when the vehicle exceeds the velocity limit. In the case the moving object is a ship, the warning could consist of bad weather ahead.

According to the second aspect, the present invention relates to a registration system for determining a track record of a moving object by determining at least one characteristic properties of the object, said system comprising:

- receiving at least three Global-Positioning-System (GPS) coordinates, each of the coordinates comprising the current position of the moving object and the current time, at which the moving object is at the current position,
- storing said coordinates data in a storage means,
- utilizing the at least three coordinates for determining said at least one characteristic properties of the moving object,

and thereby obtaining a track record for the moving object, wherein the track record comprises information related to:

- direction of movement
- velocity
- perpendicular acceleration

and wherein said track record data is utilized to create user information.

In one preferred embodiment the system further comprising a transceiver for transmitting data from the registration system and/or receiving data. The computer system may be located external from the registration system, in the case the size of the system is to be minimized. This would be the case if the system would be used in a motor running vehicle, such as a car. The powering could be through the electric system of the moving object, such as through the cigarette lighter or by providing it with a battery, preferably rechargeable. The data would then simply be transmitted from the system to a computer

system, such as through a wireless network system, which may be a satellite system and/or telephone network and/or radio transmitting system and/or mobile telephone system and/or infrared data transmission, or a system based on Blue Tooth technology where the characteristic properties are determined.

If on the other hand the moving object is larger, the computer system could be integrated into the system, and not be on the receiver's side. If the moving object is an airplane, this system can be regarded as an additional data storage and processing means comprising information relating to at least one of the following data:

- keeping inside recommended 3-dimensional geo-fence,
- speed and/or variations thereof,
- linear acceleration,
- ~~centripetal acceleration~~perpendicular acceleration
- altitude and/or variations thereof, and
- position,

wherein real time processing of said data can be transformed into a signal and obtained by a receiver.

In another preferred embodiment the system is provided with at least one sensor for determining at least one environmental parameter and associated with a GPS coordinate. These parameters may as an example is precipitation, temperature, moisture, wind-speed etc.

Detailed description

In the following the present invention, and in particular preferred embodiments thereof, will be described in greater details in connection with the accompanying drawings in which

Figure 1 shows an overview over the system for determining a track record of a moving object,

Figure 2 shows how received and calculated data is stored in the system,

Figure 3 shows a flow diagram of how the downloaded data in the system is published through user intervention to a map or a report, and

Figure 4 shows one embodiment of how the ~~centripetal acceleration~~perpendicular acceleration may be determined from an automobile driving in a curve.

Figure 1 shows an overview over the system for determining a track record of a moving object, where the moving object is a car 2. In this example the car is provided with a registration system 3 comprising a Global-Positioning-System (GPS) with an antenna such as ceramic patch, passive antenna for receiving plurality of GPS coordinates from a satellites 1 and a storage means for storing said coordinates. These coordinates give the position of the car 2 as well as the time. The system may be powered by plugging it to the electric system of the car, i.e. the cigarette lighter. The system may also be powered through battery or any other kind of power source. After collecting a plurality of GPS coordinates, such as after one driving cycle, the coordinates are transmitted to a receiver, where at least one characteristic property of the car is determined. Transmitting the coordinates data by be done manually 5 or through wireless communication 7, such as through satellites system, telephone network, the Internet or by utilizing Blue Tooth technology. On the receiver side software 8 utilizes the coordinates for calculating at least one characteristic property of the car, which may be the velocity, the total travelled distance, the acceleration, the ~~centripetal acceleration~~perpendicular acceleration and all variations thereof. A track record 9 of the car is obtained comprising information relating to the driving in this driving cycle. As an example the track record shows the total distance in the driving cycle, where the speed of the car exceeded a predetermined speed limit, and where exactly (with a street name) this event occurred, the speed of the car in a curve, which is determined from the ~~centripetal acceleration~~perpendicular acceleration.

In another embodiment the at least one characteristic property of the system may be determined during or after collecting a plurality of GPS coordinates points, so that the data transmitted to a receiver are fully processed data. One application of this is when implementing the system to an airplane, where both the positioning of the airplane as well as other characteristic properties are monitored. The receiver, in this case the air-traffic control would receive information relating to if the airplane is inside recommended

3-dimensional geo-fence or not, the speed and/or variations thereof, the linear acceleration, the ~~centripetal acceleration~~perpendicular acceleration altitude and/or variations thereof, and position. Preferably, the system would be provided with receiving means for receiving signals from, in this case, the air-traffic control, which could be warnings.

The essential part here is to receive GPS-coordinates points and utilize these data points in determining characteristic property for an moving object. The moving object may as well be any kind of motor vehicle, a ship etc.

Figure 2 shows how received and calculated data is stored in the system and how the system determines a track record of a moving object, wherein antenna 11 receive a GPS satellite signal, giving a coordinate of a moving object. A microprocessor 12, preferably a SiRFStar-II chip receives the coordinate data, and stores the data in a storage means 13, preferably a Flash memory. A firmware 14 is also provided for controlling what information goes into the memory and how it is packed and organized. The firmware controls and constructs the data transferred to the flash memory. The data construction is based on data package system. Every data package comprises a number of measurements. First record of data in the package is a full version of the data, a Timestamp (Timestamp ID, full position, full date and a full time).

The rest of data package comes in sets of a predetermined number of measurements and every set ends with a checksum for data reliability verification. Every measurement comprises of a relative number from the last position and a relative number from the time/date in the timestamp.

As an example one data package consists of 28 data including the timestamp data point (x_T, y_T, t_T). This timestamp data point is used as a reference points for the subsequent data points in the data package. The timestamp gives the exact position, usually in latitude and longitude coordinates, of the object (x_T, y_T) as well as an exact date t_T, i.e. year, month, day and time. The subsequent data points in this package show the deviation from these coordinates, i.e. (Δx_i, Δy_i, Δt_i) where $\Delta x_i = x_T - x_i$ and $\Delta y_i = y_T - y_i$ with x_i and y_i is the absolute position of later coming GPS-coordinates in the x-and y-axis (i.e north and south, or latitude and longitude) and $\Delta t_i = t_T - t_i$ is the elapsed time interval from t_T. This deviation may also be the deviation from the adjacent GPS-coordinate, so

Accordingly each increment package with three increment elements require only 20 bytes, versus 20 bytes for only one Timestamp coordinate point. Therefore, if each data point in the increment packages would be a Timestamp point instead of increment element, each increment package would require 3*20 bytes=60 bytes, instead of 20 bytes. Therefore the data capacity in the present system is enlarged.

The checksum could as well be the in the second, fourth, fifth etc. increment element in the increment package.

Figure 3 shows a flow diagram of how the data in the system is downloaded to a receiver. The raw measurement data in the device's memory is downloaded to the system and saved for later processing 22. In this embodiment the data decode 21 is the part of the system were data is decoded from a raw-data file. The decoded raw data is then filtered 23 according to specified criteria, such as if there is an error in the calculating a characteristic property, such as the acceleration is too large, it will not be shown, and it can also happen that the same coordinate point is collected twice. In this level all calculations in the at least one characteristic property of the moving object are performed on the decoded data and filters are applied where needed. The final processed data is then stored in a database table 24 and is ready to be used for publishing reports and displaying maps. Information from this database is published 25 according to user set criteria 28 and displayed either on maps 27 or in reports 26. The user can, as an example, specify start and end time of reports, maximum or minimum of at least one of the moving vehicle's characteristics, the duration of a vehicle standstill and etc.

Figure 4 shows one embodiment of how the ~~centripetal acceleration~~perpendicular acceleration may be determined from an automobile 30 driving in a curve. A plurality of GPS coordinates points including the timestamp 31 is shown. All subsequent GPS coordinate points are, as mentioned earlier, the variation from the timestamp. In this example and in a simplified picture assuming the coordinates are as real coordinates, the transversal (T) speed $V_{i,T}$ and $V_{i+1,T}$ of the automobile is determined through:

$$Vi,T = \frac{\sqrt{((x(i)-x(i-1))^2+(y(i)-y(i-1))^2)}}{t(i)-t(i-1)}, \quad (1)$$

$$Vi+1,T = \frac{\sqrt{((x(i+1)-x(i))^2+(y(i+1)-y(i))^2)}}{t(i+1)-t(i)}, \quad (2)$$

where the travelled distance is the distance between two points, in this case adjacent points utilizing Pythagorean theorem. The radius R 38 of the curved path, is where the vectors $r_{i,p}$ 36 and $r_{i+1,p}$,perpendicular to the tangent in the two points, intersect 39. These two vectors are given as:

r_i=(x(i)-xT-x(c),y(i)-yT-y(c)) and r_{i+1}=(x(i+1)-xT-x(c),y(i+1)-yT-y(c)),

with (xc,yc) as the intersection point. Using standard vector calculations the intersection (xc,yc) 39 is obtained and therefore the radius R 38, from which the perpendicular acceleration is obtained, i.e.

$a_{cent}=V^2_{i,T}/R$.

Also by summing up the distance between two points, preferably adjacent points, by using Pythagorean theorem as shown in Eqs. (1) and (2) the total travelling distance of the automobile is obtained.

However in reality, the GPS coordinates are presented as latitude and longitude coordinates. In one preferred embodiment the GPS technology, WGS-84 (World Geodetic System 1984) is used. This model assumes an ellipsoid with a semi-major axis (equatorial radius) a = 6,378,137 m, and a semi-minor axis (polar radius) b = 6,356,752.3142 m (defined as 1/f = 1/298.257223563, where f=(a-b)/a).

Usually, an agricultural field has relatively small size (with respect to the Earth), and may be considered as a flat surface at a particular location on the Earth. Therefore, in order to convert geographic coordinates into linear units (real coordinates) it is necessary to define the distance corresponding to a 1° change in longitude (F_{lon}) and latitude (F_{lat}) for a specific field location (average geographic latitude φ and height over ellipsoid h).

Claims

1. A method for determining a track record of a moving object by determining at least one characteristic properties of the object, said method comprising:

- receiving at least three Global-Positioning-System (GPS) coordinates, each of the coordinates comprising the current position of the moving object and the current time, at which the moving object is at the current position,
- storing said coordinates data in a storage means,
- utilizing the at least three coordinates for determining said at least one characteristic properties of the moving object,

and thereby obtaining a track record for the moving object, wherein the track record comprises information related to:

- direction of movement
- velocity
- perpendicular acceleration

and wherein said track record data is utilized to create user information.

2. A method according to claim 1, wherein the rate of collecting the GPS-coordinates and/or determining the at least one characteristic property data of the moving object is in the range of 0.01-2 seconds, preferably 0.5-1.5 seconds, and more preferably 0.8-1.2 seconds.

3. A method according to claims 1 or 2, wherein the moving object collects the first GPS data when its engine is running.

4. A method according to any of the preceding claims, wherein the collection of the GPS data is based on starting and shutting down the engine of the moving object.

5. A method according to any of the preceding claims, wherein the moving object collects the first GPS data when it exceeds a predetermined velocity limit.

6. A method according to any of the preceding claims, wherein the coordinates data are stored as at least one data package, the at least one data package comprising at least one timestamp coordinate point as a reference point for said at least one data package, the timestamp giving the absolute position and absolute time of the moving object, and a plurality of coordinate data points as a deviation from the timestamp coordinate point.

7. A method according to any of the preceding claims, wherein the at least one characteristic property of the object is determined and stored prior to transmitting the GPS and characteristic property data to a computer system.

8. A method according to any of the preceding claims, wherein the track record of the moving object for a predetermined time limit comprises at least one of the following data:

- the total distance the automobile has travelled,
- the total time the automobile has been driving,
- where and/or when said predetermined limits has been exceeded,
- the speed,
- the acceleration,
- the perpendicular acceleration,
- the position,
- the brake distance, and
- at what speed the moving object was most frequently moving.

9. A method according to any of the preceding claims, wherein the track record comprises linking the position and/the time of the moving object to each of the at least one characteristic property data.

10. A method according to any of the preceding claims, further comprising means for obtaining at least one environmental parameter, wherein each of said parameters can be associated with a GPS coordinate.

11. A method according to any of the preceding claims, wherein the at least one environmental parameters is such as precipitation, temperature, moisture, or wind-speed.

12. A method according to any of the preceding claims, wherein the at least one environmental parameters influence how the upper-and lower limit of the at least one characteristic property is defined.

13. A method according to any of the preceding claims, further comprising means for transmitting the track record data and optionally the at least one characteristic property data through a wireless network to a recipient.

14. A method according to any of the preceding claims, wherein the GPS coordinates are transmitted to a computer system on a receiver side.

15. A method according to any of the preceding claims, wherein the information comprise any of the following:

- moving manner,
- velocity comparison with a velocity database,

wherein the velocity database includes information about upper and lower velocity limits in certain areas.

16. A method according to any of the preceding claims, wherein the at least one characteristic property of the object is determined in the computer system subsequently after transmitting the GPS data to the computer system and based thereon the track record of the moving object is obtained.

17. A method according to any of the preceding claims, wherein the user is the moving object.

18. A method according to any of the preceding claims, wherein the at least one characteristic property data are transmitted to a receiver repeatedly.

19. A method according to any of the preceding claims, further comprising means for receiving user information from the receiver.

20. A method according to any of the preceding claims, wherein the received user information from the receiver is a warning signal, indicating when the moving object is outside the interval defined by the upper and lower limit of the at least one characteristic property.

21. A method according to any of the preceding claims, wherein the moving object is a motor vehicle.

22. A method according to claims, wherein the moving object is an airplane.

23. A method according to claim 22, wherein the track record of the airplane comprises at least one of the following data:

- keeping inside recommended 3-dimensional geo-fence,
- speed and/or variations thereof,
- linear acceleration,
- perpendicular acceleration
- altitude and/or variations thereof, and
- position,

wherein real time processing of said data can be transformed into a signal and obtained by a receiver.

24. A method according to claims 1-20, wherein the receiver is air-traffic controller.

25. A method according to claims 1-20, wherein the moving object is a ship.

26. A registration system for determining a track record of a moving object by determining at least one characteristic properties of the object, said system comprising:

- means for receiving at least three Global-Positioning-System (GPS) coordinates, each of the coordinates comprising the current position of the moving object and the current time, at which the moving object is at the current position,
- means for storing said coordinates data in a storage means,

- means for utilizing the at least three coordinates for determining said at least one characteristic properties of the moving object,

and thereby obtaining a track record for the moving object, wherein the track record comprises information related to:

- direction of movement
- velocity
- perpendicular acceleration

and wherein said track record data is utilized to create user information.

27. A system according to claim 26, further comprising at least one sensor for measuring at least one environmental parameter and associate said parameter with a GPS coordinate.

28. A system according to claims 26 or 27, further comprising a transceiver for transmitting and/or receiving data from the registration system.

29. A system according to any of the claims 26-28, wherein a computer system is located external from the registration system.

30. A system according to any of the claims 26-29, wherein the data transmitting and/or data receiving is performed through a wireless network system.

31. A system according to claim30, wherein the wireless network is a satellite system and/or telephone network and/or radio transmitting system and/or mobile telephone system and/or infrared data transmission.

32. A system according to any of the claims 26-31, wherein the moving object is a motor vehicle.

33. A system according to claim 32, wherein the registration system is plugged to the electric system of the motor vehicle for powering the registration system.

34. A system according to claim 32, wherein the registration system is provided with a battery for powering the registration system.

35. A system according to any of the claims 26-31, wherein the moving object is an airplane and the system is an additional data storage and processing means comprising information relating to at least one of the following data:

- keeping inside recommended 3-dimensional geo-fence,
- speed and/or variations thereof,
- linear acceleration,
- perpendicular acceleration
- altitude and/or variations thereof, and
- position,

wherein real time processing of said data can be transformed into a signal and obtained by a receiver.

36. A system according to any of the claim 35, wherein the receiver is air-traffic controller.